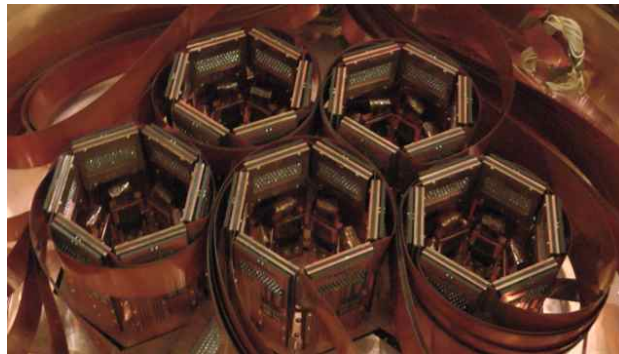
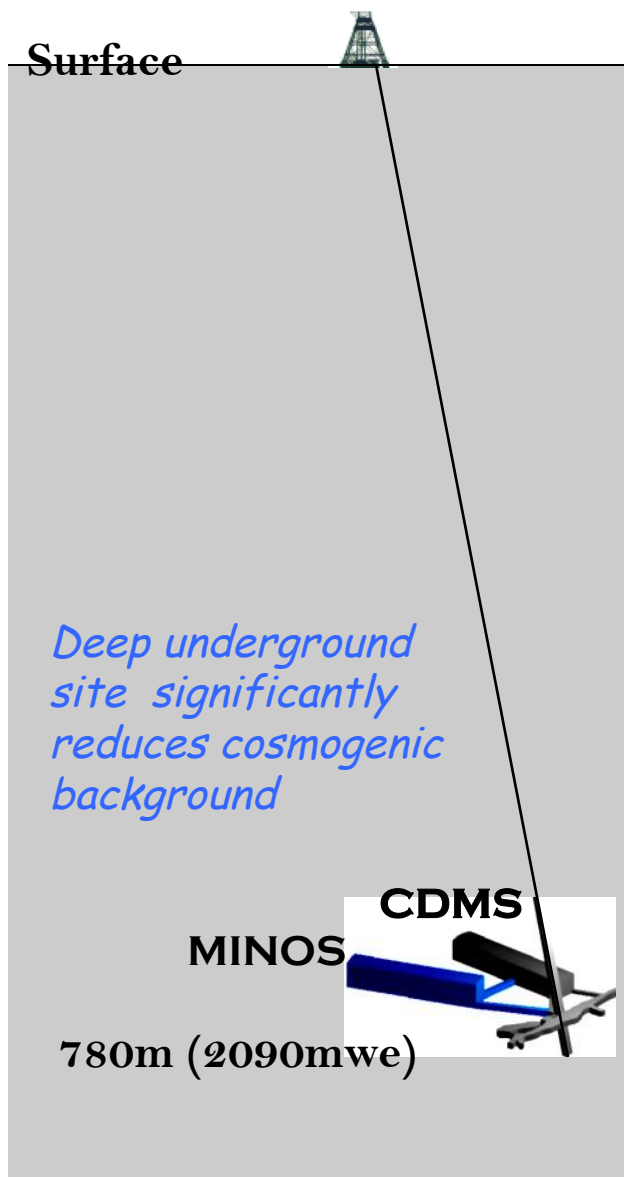


SuperCDMS: New Payload Operation at Soudan Mine

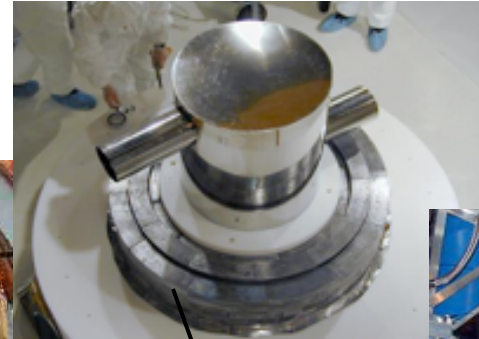


Lauren Hsu
Fermilab AEM December 12, 2011

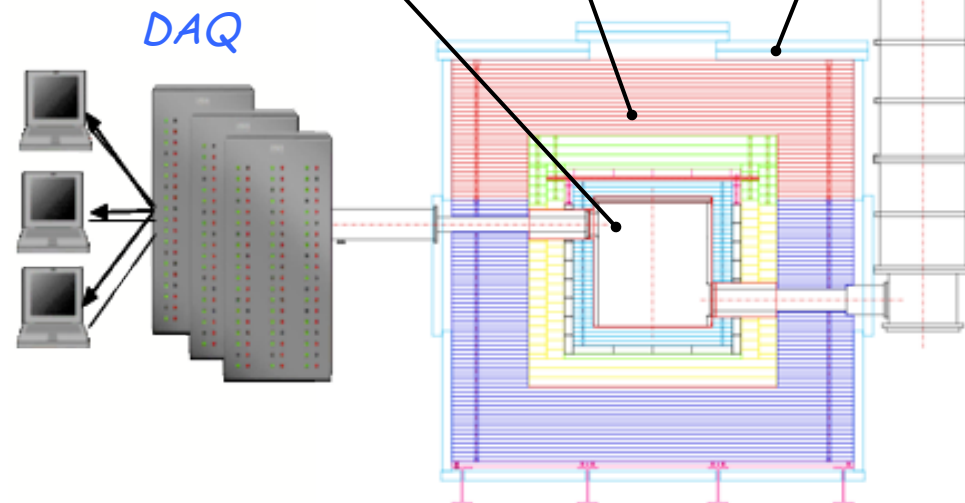
Experiment Overview



Detectors reside in the "icebox"



Lead, poly and scintillator provide additional shielding



Cryogenic system cools detectors to ~50 mK, needed for phonon detection

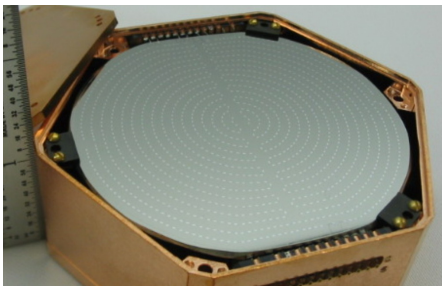
CDMS Hardware Vocab

Cold end connects to SQUET card



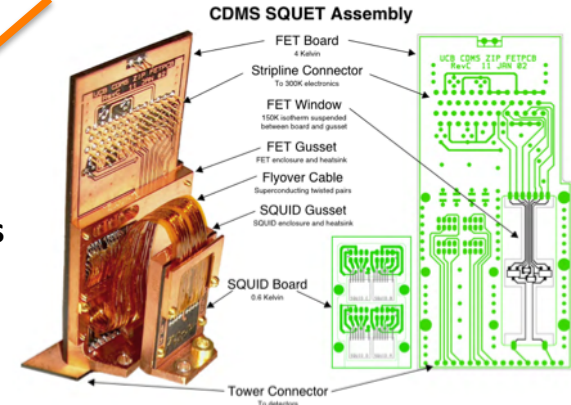
Warm end breaks out at the **EBox**

Stripline = flexible copper + kapton cables, carry detector signals out to room temp.



iZIP = 1-inch Ge crystal, ~0.6 kg each, interleaved charge and phonon sensor design

SQUET = FET + SQUID



Cold Electronics

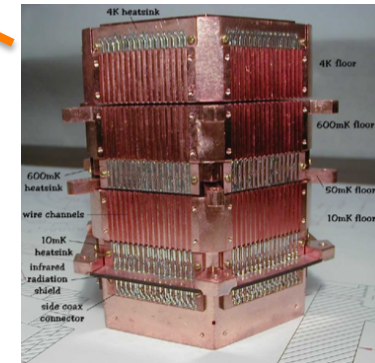
Tower assembly

Stripline

Side coaxial cable

Ge Detector stack

9.5 kg total
15 detectors arranged in 5 towers



Tower = 4 temperature stages (4K, 600 mK, 50 mK and 10 mK) heat sunk to different stages of the fridge via nested layers of the icebox

What has CDMS been up to recently?

Dec. '09: Final CDMS II dataset analyzed, 2 events seen, consistent w/ surface event bg

Spring '09 - Spring '11: Two separate “engineering” installations to test 1-inch thick detector designs: mZIP and iZIP

March '11: Fire in Soudan shaft prematurely ends Spring engineering run, CDMS survives sudden warmup from base temp (thankfully) without incident

Summer '11: iZIP design wins out, fabrication of full payload completed at the end of the summer, at least 10X better surface event rejection expected from SuperCDMS

Major Milestones Since Spring Shutdown

- **September:** Fabrication and testing of SuperCDMS payload completed
- **October:** Best-performing detectors selected and assembled into 5 towers (total ~ 10 kg Ge, 15 detectors)
- **October 25:** Safe delivery of detectors to Soudan after cross-country ground transport (driver condition not as good as the detectors upon arrival)
- **November 8:** Tower installation complete, icebox closed
- **November 29:** Hit base temperature (60 mK), confirmed at detector thermal stage, 3 days ahead of schedule (!)

Other Activities

- Ongoing repair and reinforcement to mine shaft restricts access more than usual
- Backup diesel generator for CDMS was a casualty of the fire, replaced with a new generator that can supply power to the whole experiment (48+ hrs) in the event of a blackout.
- Working out ongoing teething problems with new He and N liquefiers (used to recycle exhaust and reduce overall consumption of cryogenics)
- Development of new automated data quality system
- Minor upgrades to data acquisition hardware - several computers replaced or decommissioned, digitization reconfiguration, trigger logic updates

SuperCDMS 5-Tower Installation

- Only detectors were replaced in current installation, other components, including cold hardware reused from CDMS II
- An opportunity to train new people (significant changes in personnel taking place this year)
- First CDMS installation to undergo thorough documentation in the form of videos and photos

Set a new record for fewest problems during an installation!

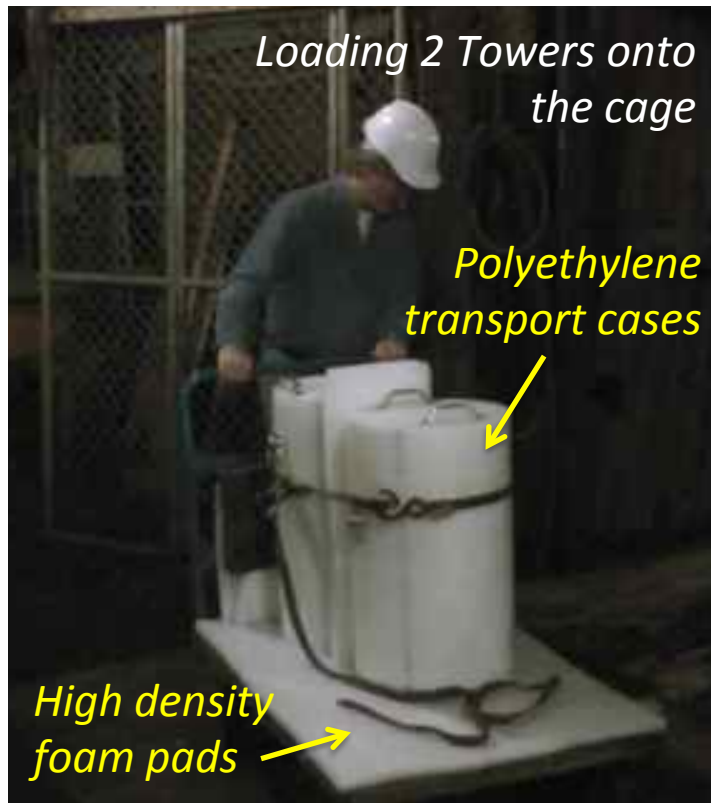


View overlooking icebox, Nov. 1 2011

Photo-log of SuperCDMS Installation

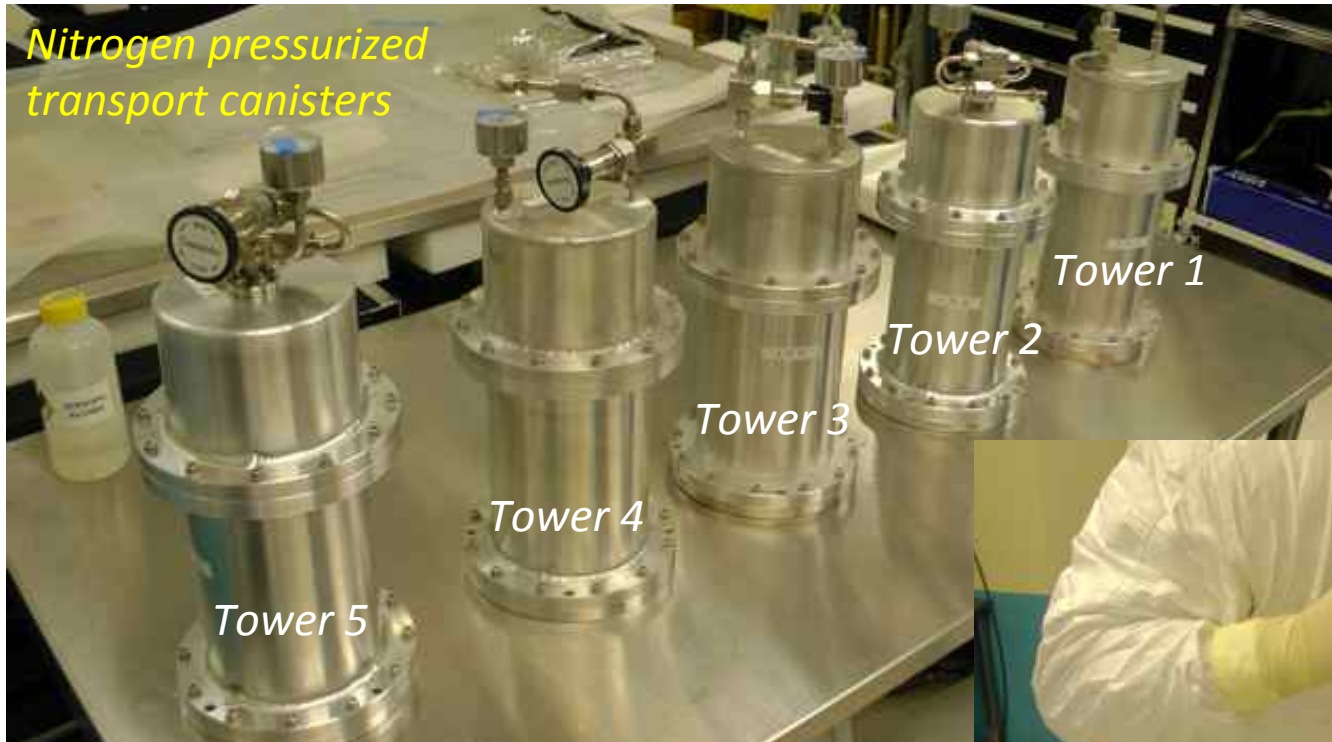
Delivery and Transport Underground

Tuesday October 25



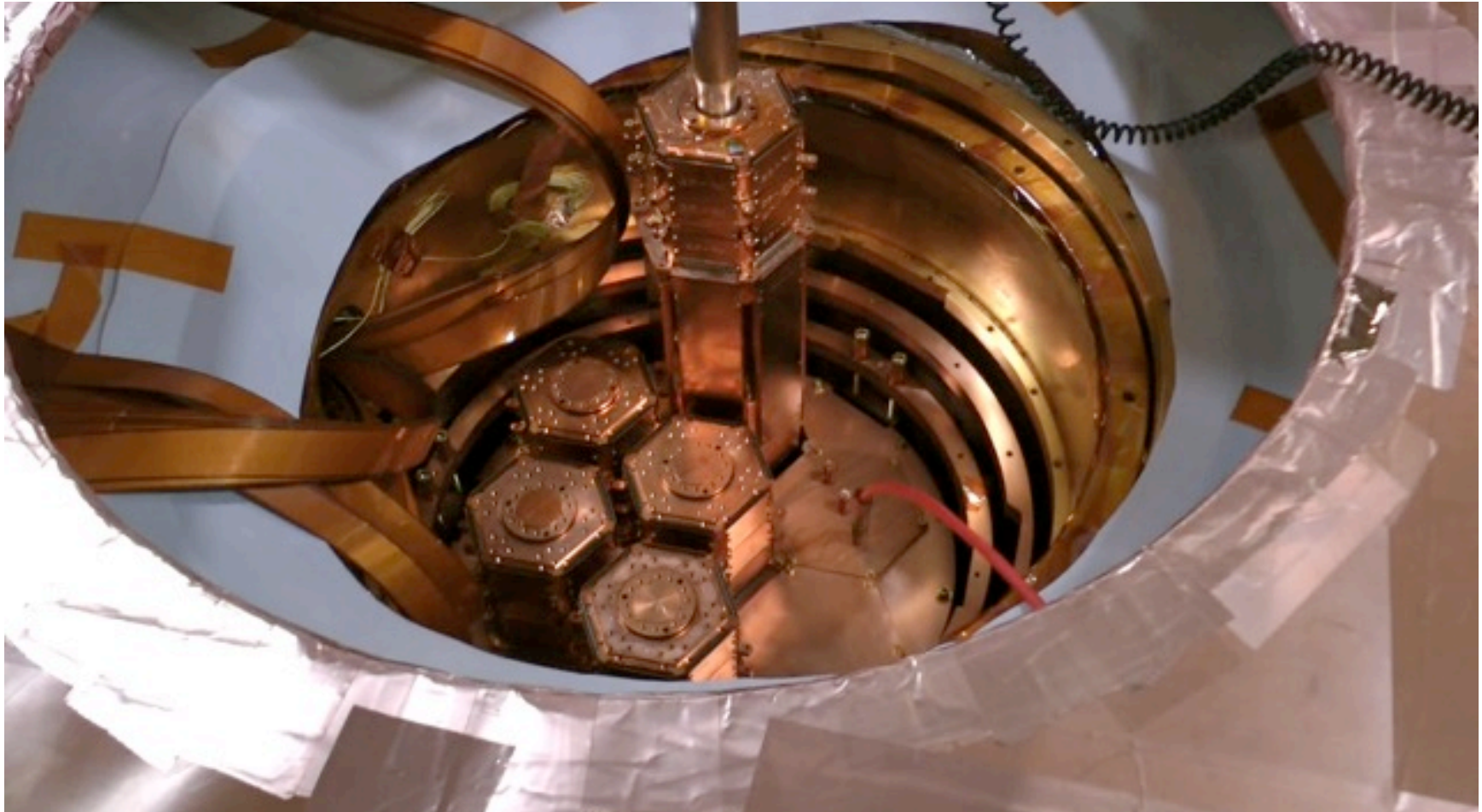
Unpacking

*Tuesday
October 25*



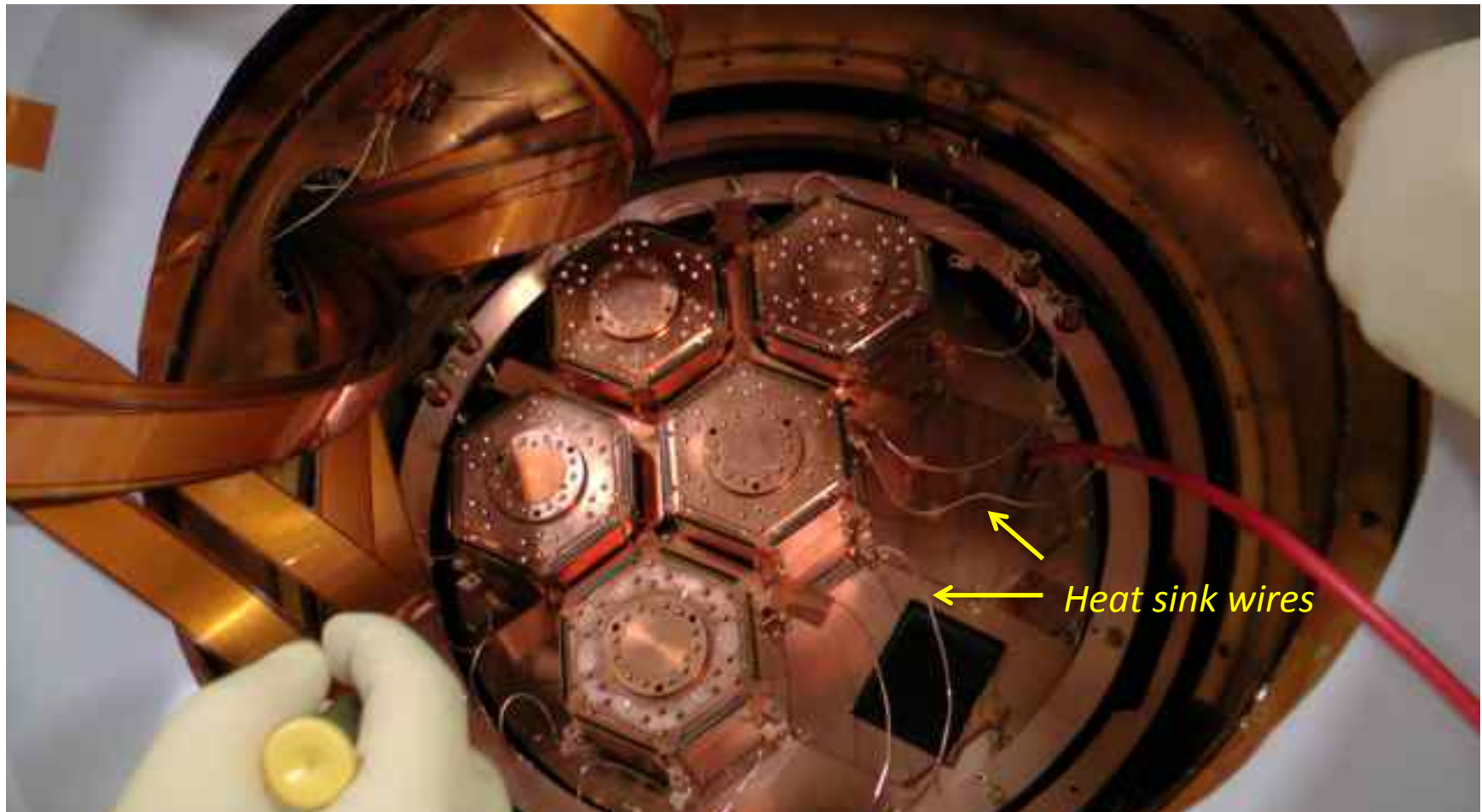
Inserting Tower 3 into the Icebox

Thursday October 27



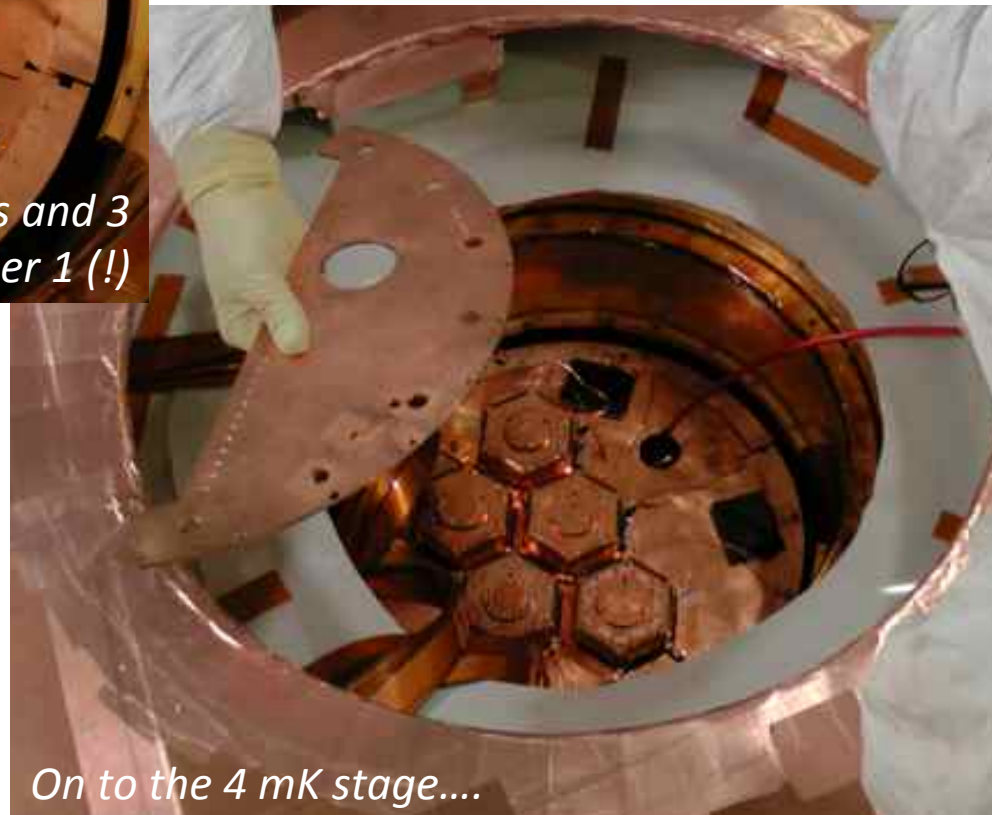
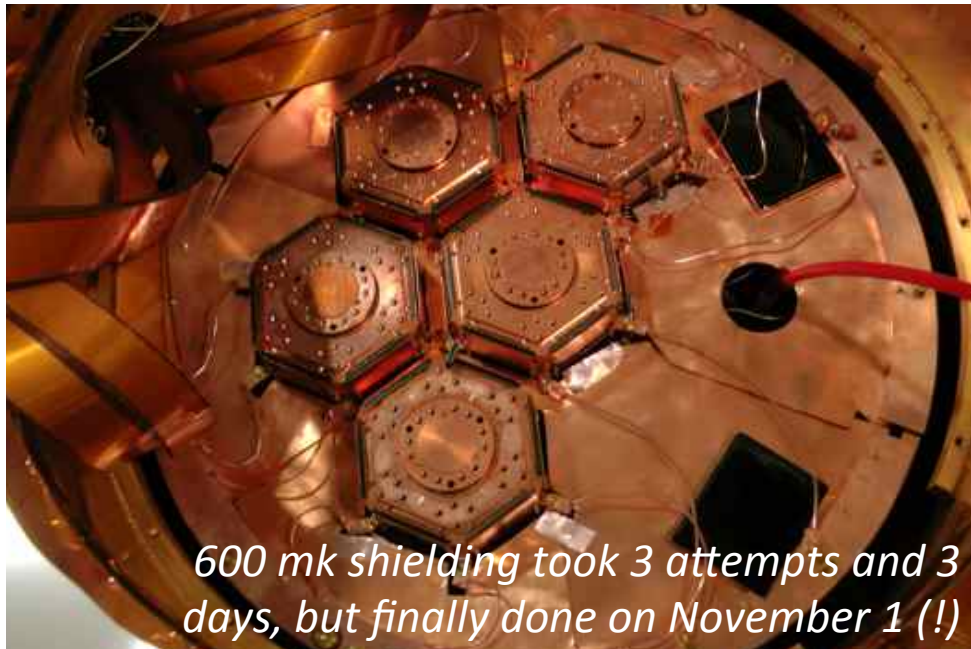
10 and 50 mK Thermal Connections In Place

Friday October 28



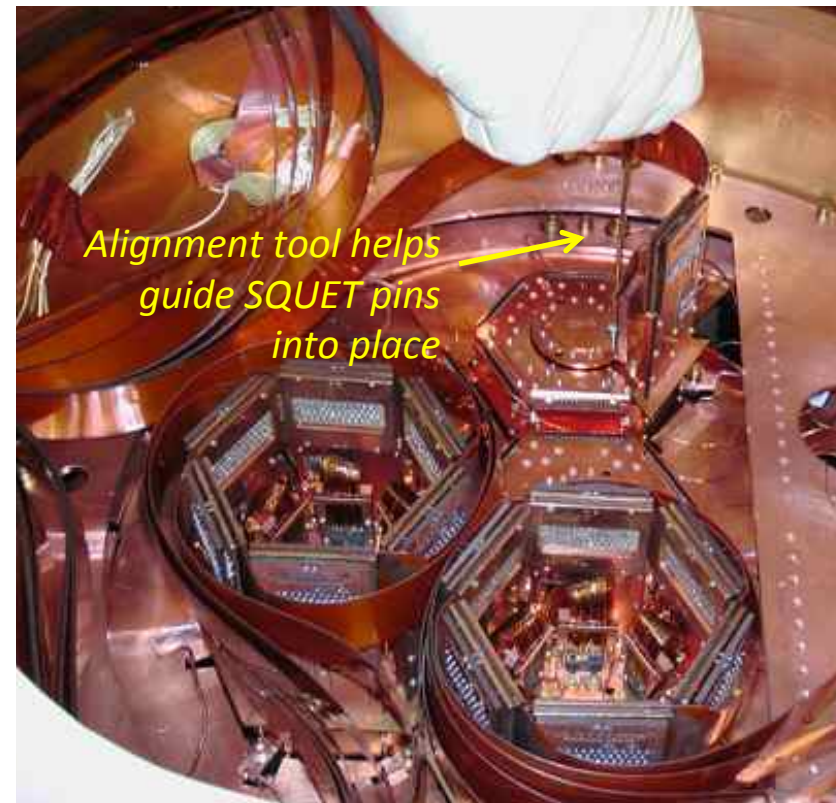
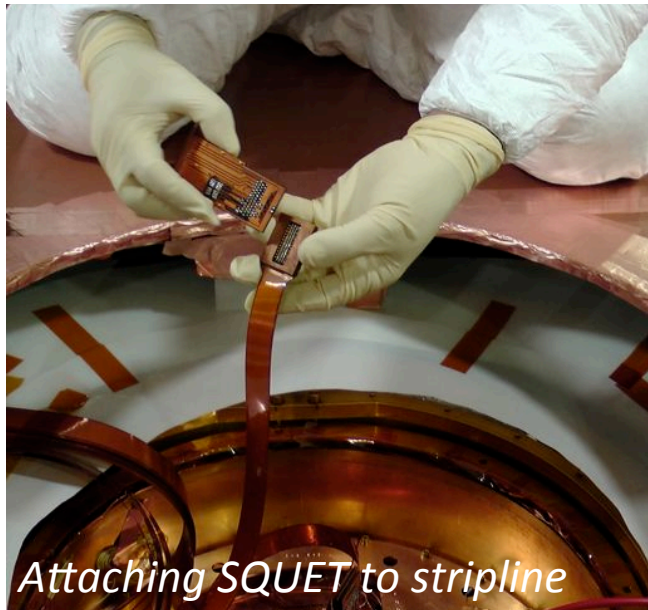
Rebuilding the IR Shielding

Tuesday November 1



Cold Hardware Installation

*Tuesday – Thursday
November 1-3*



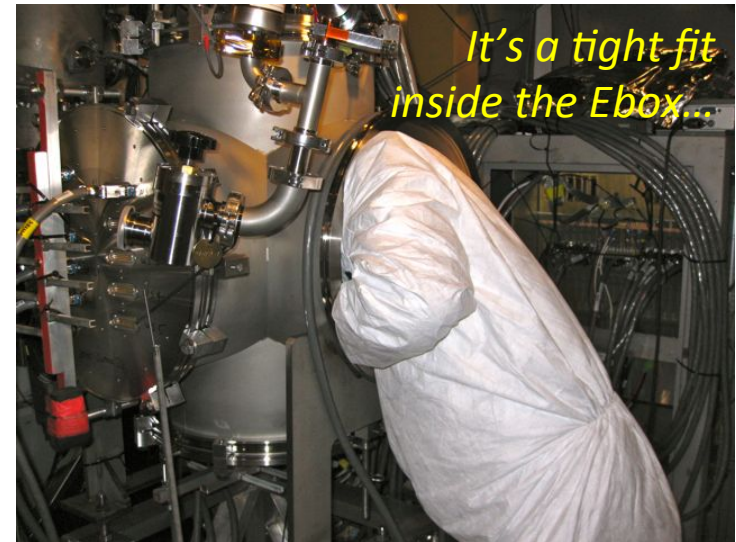
*13 SQUET cards installed only
17 more to go...*

Thermometry and Final Adjustments at the 4K Stage

*Friday – Tuesday
November 3-8*

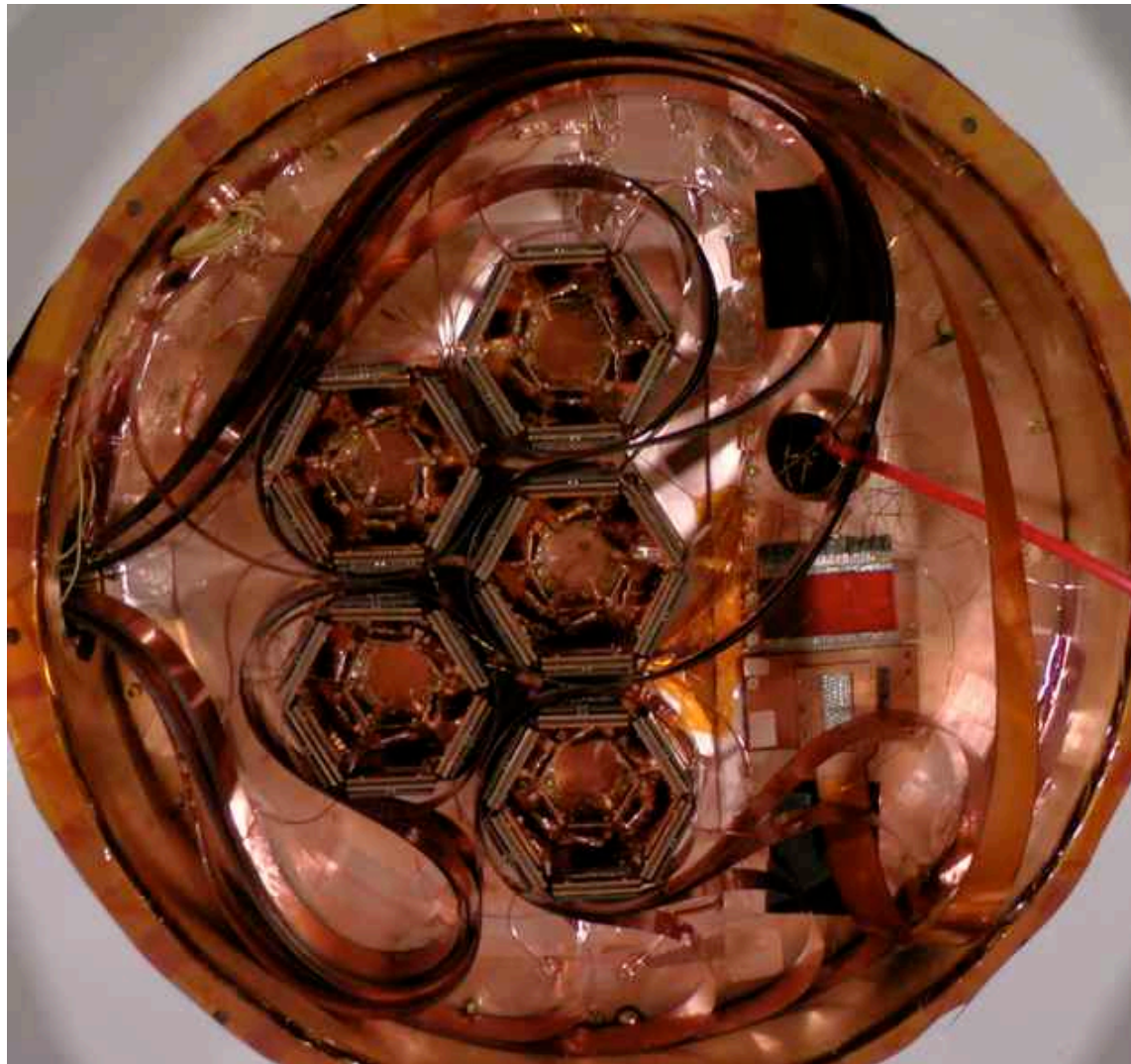


Cabling and Continuity Checks



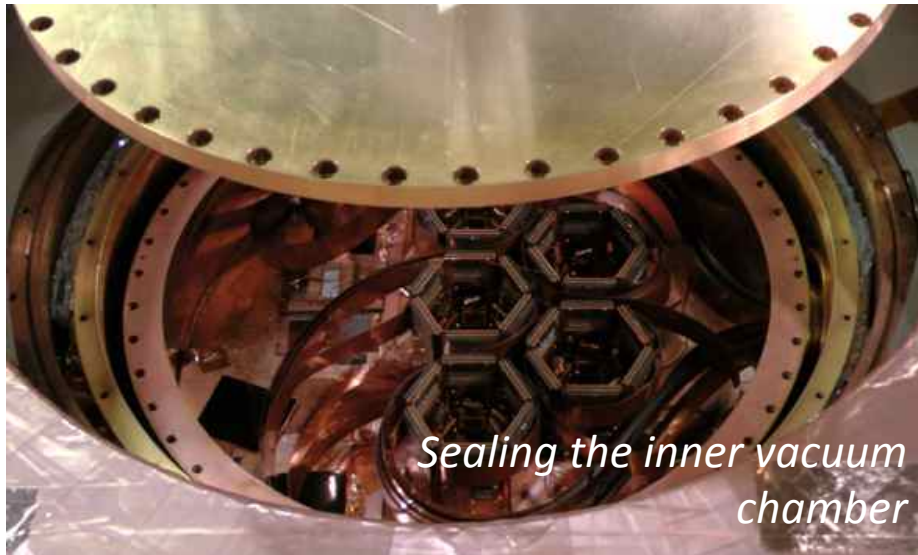
Installation Complete !

Tuesday November 8



Closing the Icebox

Tuesday November 8



Pump Out and Cool Down

November 8 - 29



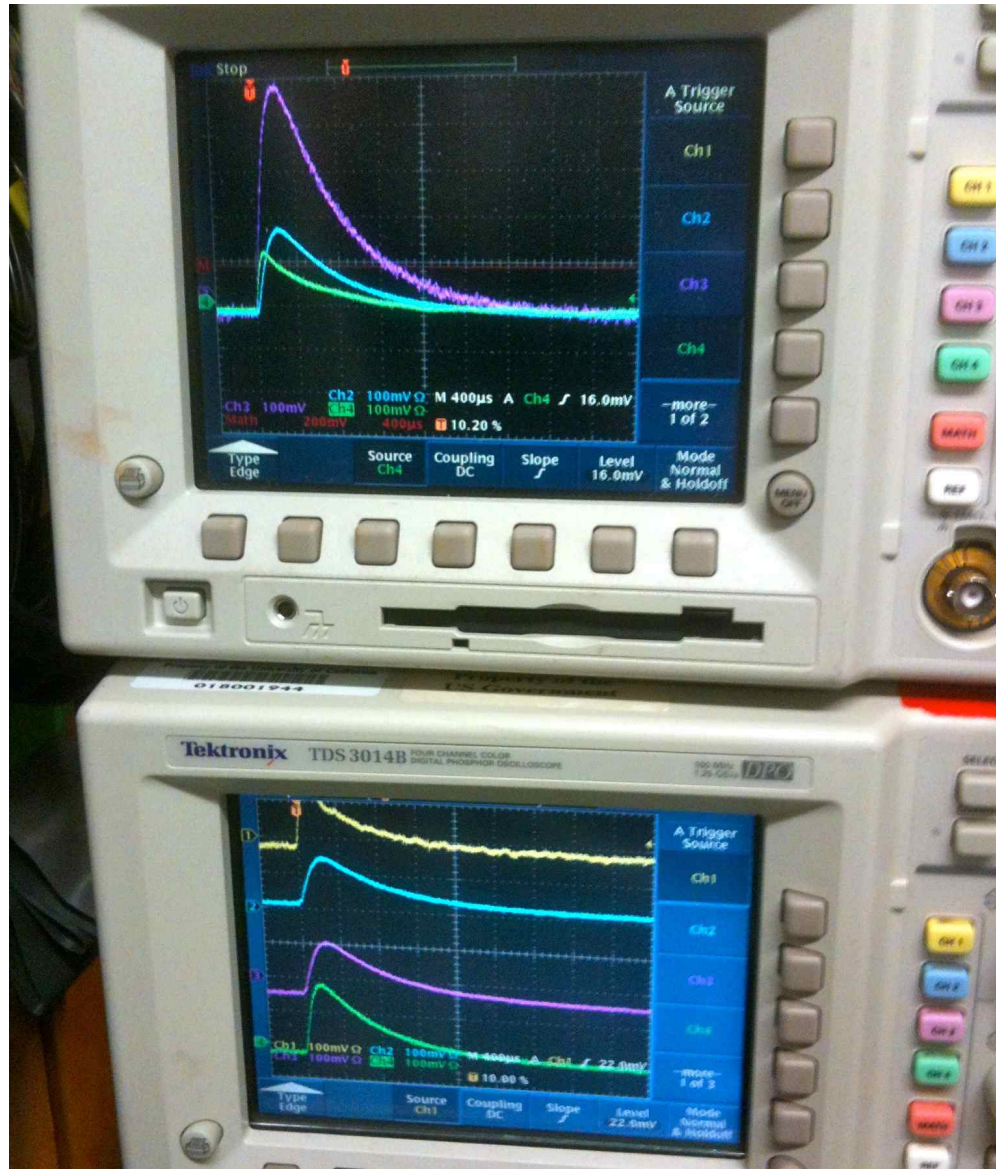
Rebuilding the Shielding

November 16-17



*Hanging muon veto (scintillator)
panels*

First Phonon Pulses from Physics Event !



*Last Friday
(Dec. 9)*

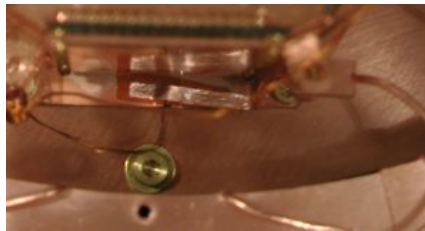
Showing 7 of 8
phonon channels
on a single iZIP
(still tuning
settings on 8th)

Continuity
checked out ok
on > 99% of
channels

Minor Installation Snags

Very smooth installation when considering aging infrastructure and re-use of cold hardware

- Chassis short on tower thermometry, found and fixed



Closeup of "surgical repair"

- Installation of cold hardware results in one broken stripline. Solved by last minute swap with thermometry stripline



Base Temperature

Smoothest cool-down in recent memory, no incidents

- Base temperature slightly higher than past operation (~60 mK compared to ~50 mK)
- All detectors expected to be operational
- Thought to be due to slight thermal touch between two temperature stages or poor thermal contact at the 50 mK stage

Next Steps

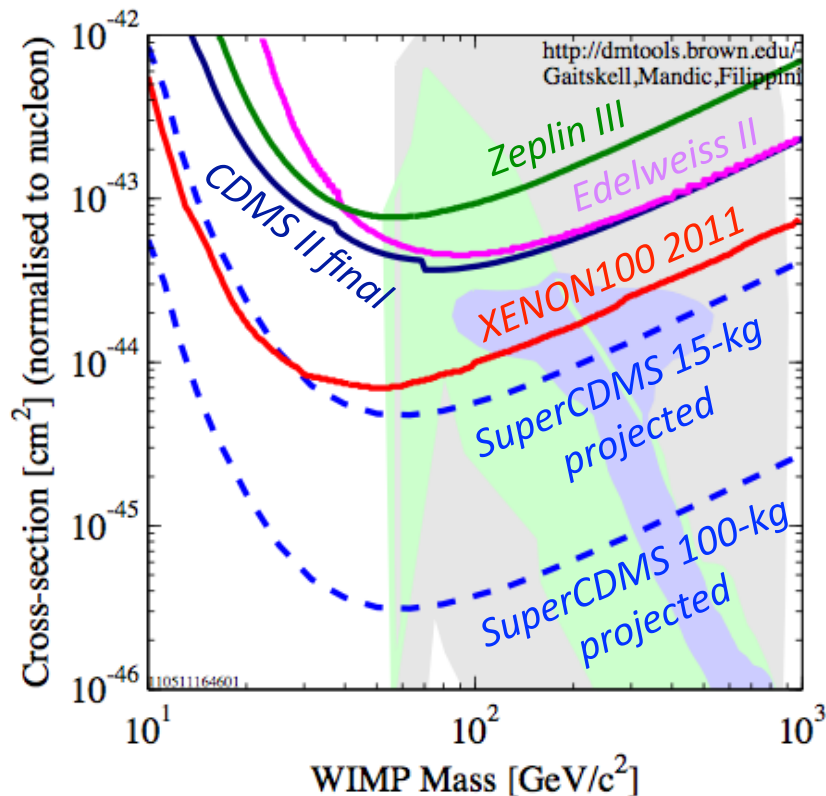
- Turn on remaining detectors
- Determine operating conditions (optimize for detector stability and noise)
- Data Quality system commissioning
- Repair He liquefier (one of two failed and returned to manufacturer for repair)

Search for WIMPs (!)

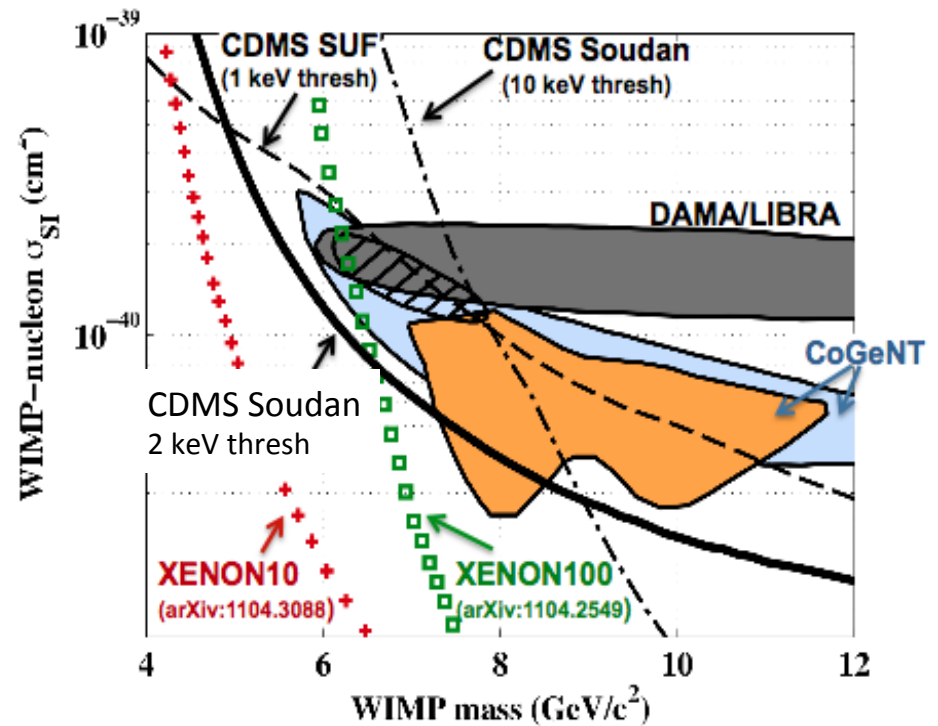
Backup

Where things stand

So far, no clear evidence for WIMPs, but much progress made in probing interesting theoretical regions



*Spin-Independent scattering
above $10 \text{ GeV}/c^2$ WIMP masses*



*Spin-Independent scattering
below $10 \text{ GeV}/c^2$ WIMP masses*

Make Sure the Thermal Contact Points are Clean!

